

CUSTOMER-SIDE MARKET SEGMENTATION

1 TECHNICAL FIELD

2 The invention relates generally to electronic commerce with businesses and, more
3 particularly to customer segmentation and customization of profiles or categorizations.
4 This segmentation is done without disclosing sensitive private customer information to
5 the business.

6 BACKGROUND

7 Businesses have a desire to be able to tailor advertising, promotions and offers to
8 individual customers to increase the likelihood of engaging their interest and making a
9 sale. Businesses are also interested in identifying people who are not likely customers so
10 that they can avoid wasting time and money on them. Since it is typically impractical to
11 gather enough data about a potential customer to make customization completely
12 individual, the typical proxy is to partition the customer space into some discrete, usually
13 small, number of market segments. The individual customer is then classified or
14 categorized into a pre-defined market segment that seems to have a best fit.

15 As an example of such segmentation, a manufacturer might divide people into
16 categories such as "price conscious" vs. "novelty seeking" vs. "brand loyal" vs. "status
17 conscious" vs. "concerned with the environment" vs. "likes to think they are getting the
18 best of you." The categorization is made for the purposes of selecting a particular direct
19 mail (physical mail or e-mail) pitch to send to potential customers. A department store or
20 web site, on the other hand, might be concerned with deciding to which department the
21 customer should be steered.

22 Typically, information is obtained about a customer by looking at past behavior of
23 that customer, either when interacting with this particular party, or from information
24 purchased from third parties. The information might be valid, but there is always a
25 question of how representative the information is and how much predictive power it has.
26 There is an additional problem in that the identity of a customer is assumed, or at least a
27 stable proxy for the customer. When customers are anonymous, there is no way to glean
28 information about them. There is also a problem categorizing new customers, for whom
29 no information yet exists.

30 An alternative way to obtain information is to have the customer fill out a
31 questionnaire. This is time consuming and often seen as intrusive. It is also unlikely to

1 reveal true answers, which may or may not be a problem, depending on the assumptions
2 used in creating the rules.

3 The main conflict is that on one hand, customers are justifiably wary about giving
4 out personal information and about businesses knowing too much about them. On the
5 other hand, customers appreciate it when customization works and businesses correctly
6 determine what a customer will find interesting and avoid showing the customer things
7 that will not be found interesting.

8 It is desirable for users of e-commerce to maintain privacy of personal data while
9 also receiving targeted offers of interest. Data mining past interaction behavior with e-
10 commerce web sites is error-prone, intrusive and foiled when a user chooses to remain
11 anonymous. Further, mining of past interaction may not necessarily be predictive of
12 future interactions.

13 In some cases, customers are asked to classify themselves. This method lacks
14 uniformity, even when the customer is provided explanation. There is no way to match
15 these self-classifications to actual learned rules.

16 SUMMARY

17 It is an aspect of an embodiment of the present invention to allow customer
18 segmentation and customization without disclosing sensitive private customer
19 information to the business.

20 It is another aspect of the invention to provide customized shopping experiences
21 for anonymous shoppers.

22 These and other aspects and embodiments are achieved in a system that is well
23 suited for on-line or dynamic configuration of customer interactions.

24 According to an embodiment of the invention, a customer, first, must be willing to
25 download the categorizer onto a PC (personal computer), PDA (portable digital assistant),
26 or other device. Once the customer has control over the categorizer, his or her behavior,
27 history and demographic information begins to be stored. An initial questionnaire may be
28 shipped with the categorizer to fill in some initial blanks. The customer will have
29 incentive to answer honestly without fear that the personal information will be released to
30 third parties.

31 The customer then visits a participating business, either in person, or on-line. A
32 decision procedure particular to the business is downloaded onto the customer's
33 categorizer device. The categorizer runs the rule set and determines a category for the
34 customer. This category may change over time due to changes in the customer's answers

1 or history, or due to a change in the business' rule set. All of the calculations are
2 executed on a device controlled by the customer. The only information communicated to
3 the business is the resulting category code. A customer may choose to turn off the
4 categorizer, possibly a plug-in to a web browser for e-business visits, or leave the portable
5 device off or at home when visiting a business.

6 Once the business receives a category code, it has the option of acting or doing
7 nothing. For some categories, doing nothing is appropriate, for instance, for the "leave
8 me alone while I shop" category. In other cases, coupons, discounts, advertisements or
9 other promotional literature could be printed, or displayed on a customer's device. In yet
10 another case, notices may be sent to salespeople to alert them that a customer needs
11 assistance. In another case, a notification may be sent to an affiliated service or business,
12 which then sends promotional material to the customer in the form of a pop-up ad or e-
13 mail, or similar, for the case of e-businesses. Depending on what information a customer
14 is willing to provide, *i.e.*, e-mail address, postal address, etc., various embodiments will
15 be able contact or notify the customer of prospective promotions.

16 **DESCRIPTION OF THE DRAWINGS**

17 The detailed description will refer to the following drawings, wherein like
18 numerals refer to like elements, and wherein:

19 FIGURE 1 is a flow diagram showing a method for obtaining rules to be used in a
20 categorizer;

21 FIGURE 2 is a flow diagram showing an alternative method for obtaining rules to
22 be used in a categorizer;

23 FIGURE 3 is a flow diagram illustrating an embodiment of the present invention;
24 and

25 FIGURE 4 is a block diagram of a customer's portable device and its interaction
26 with a business' promotional device.

27 **DETAILED DESCRIPTION**

28 The numerous innovative teachings of the present application will be described
29 with particular reference to the presently preferred exemplary embodiments. However, it
30 should be understood that this class of embodiments provides only a few examples of the
31 many advantageous uses of the innovative teachings herein. In general, statements made
32 in the specification of the present application do not necessarily delimit any of the various

1 claimed inventions. Moreover, some statements may apply to some inventive features but
2 not to others.

3 Referring now to the drawings, and in particular to FIGURE 1, there is illustrated
4 a flow diagram showing a method of the prior art for categorizing or segmenting a
5 population in a given market area. First, customer types of interest are identified in block
6 101. A list of potentially useful questions is generated in block 103. A sample of
7 customers is selected in block 105. Each customer is assigned a type based on past
8 behavior or interview in block 107. Customers are induced to answering questions in
9 block 109. Rules for predicting customer types are learned based on the answers to the
10 questions and other information known or believed about the customer, in block 111.
11 Finally, in block 113, questions that are deemed to be low in predictive value are pruned
12 from the set asked to customers.

13 Another method of the prior art is shown in FIGURE 2. This method differs from
14 that shown in FIGURE 1 in that the customer types are not predetermined. A list of
15 potentially useful questions is generated first, in block 201. A sample of customers is
16 then selected in block 203. A clustering algorithm is run to partition customers into
17 useful categories based on past behavior in block 205. With this method, customers are
18 also induced to answer questions, in block 207. The order of these steps may be reversed,
19 if desired. Rules for predicting customer types are learned from correlating answers to
20 questions in block 209. Finally, in block 211, questions that are deemed to be low in
21 predictive value are pruned from the set asked to customers.

22 Neither of these methods depend on the truthfulness of the customers answering
23 questions. Instead, what is learned is a rule that takes as its input "customers who answer
24 this question this way." The actual truth is irrelevant. However, an advantage of the
25 present method is that a customer will be more amenable to answering the questions
26 truthfully because private information is not revealed to the businesses.

27 In an exemplary embodiment of the present invention, a customer has a portable
28 device for storing information about himself and answering queries from merchants. The
29 device is capable of executing categorizer software that runs a decision procedure,
30 provided by a merchant, which takes as input information about the customer provided to
31 the device by the customer or observed by the device. Optionally, the device can
32 dynamically interact with the customer to request information not in its database. The
33 customer does not interact directly with the merchant, and the device communicates to the
34 merchant only the resulting classification, keeping the specific information about the

customer private. Thus, the customer's personal information is not revealed to the merchant. The decision procedure is downloaded onto the device through an interaction with a computer at the merchant's store. This communication will typically be wireless, but may involve making a physical connection.

The categorizer uses rules to determine a category for the customer. It will be apparent to one skilled in the art that the rules may be implemented using a neural network, a decision tree, complex Boolean expressions, a Bayesian network or other methods. These and other methods of implementing rules are discussed in Mitchell, T., "*Machine Learning*" (McGraw-Hill, 1997). In this text, Mitchell discusses the basics of the most popular techniques, including decision trees, neural networks, Bayesian belief networks, *k*-nearest neighbor, genetic algorithms, and rule sets. Any number of rule set implementations may be used as long as the business uses a corresponding method to define the rules. In an alternative embodiment, the customer's portable device utilizes more than one method, where each method corresponds with a different business, or set of businesses.

An example of a simple rule set for categorization includes three classes, "bargain hunter", "status seeker", and "gadget freak". For bargain hunters, a business would want to emphasize what a good deal the customer is getting. For status seeker, the business would want to emphasize how exclusive their product is. For gadget freaks, the business would want to emphasize all the bells and whistles their products have. A simple rule to be used only for illustrative purposes is:

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if (income < $30,000/yr or number of children > 2) then
    class = BARGAIN HUNTER
else if (owns a dvd writer or owned a dvd player before
    1999) then
    class = GADGET FREAK
else if (subscribes to _Architectural Digest_) then
    class = STATUS SEEKER
else
    class = BARGAIN HUNTER.
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The rule corresponds to a particular business' marketing or promotional model. In this exemplary embodiment, the business has decided that if a customer earns less than a threshold amount (\$30,000 per year) or has more than two children, that they are likely to be bargain hunters. Further, if not enough information is known to meet the rule criteria,

1 the customer will automatically be classified as a bargain hunter. While the business will
2 not have personal information on individuals, it will have the categorization code for
3 customers who use the device and that ultimately purchase goods or services from the
4 business, or at least provide feedback. The business may reassess its marketing model at
5 any time and redefine its rule sets.

6 In an exemplary embodiment, a customer's portable device will have some
7 information which has been previously stored. This previously stored information is
8 typically the result of a series of questions asked to the customer; the answers may be
9 provided by using the customer's personal computer which downloads the history to the
10 portable device, when requested. The portable device may also have data learned from
11 previous interactions with the businesses using this method.

12 A typical scenario for using the portable device is shown in FIGURE 3. Referring
13 now to FIGURE 3, first, a customer enters a store or business with the portable device in
14 step 301. The version of categorization software in use on the device is identified. The
15 business has a computer or promotional device which notices the presence of the
16 customer's portable device, in step 303. The business customizes the rule set for the
17 version of software running on the portable device in step 305. The business then sends
18 appropriate rules to the customer's portable device. The portable device receives the
19 rules in step 309. This interaction with the business is typically done wirelessly, but in
20 alternative embodiments, a customer may be required to physically connect the portable
21 device to the business' computer or promotional device. A cradle can be used to connect
22 the portable device with the business' promotional device as is done to synchronize a
23 personal digital assistant (PDA) with a personal computer (PC), *e.g.*, a "hot synch cradle."

24 In alternative embodiments, several vendors may supply categorizing software for
25 competing PDAs or other portable devices. An exemplary promotional device detects the
26 version of categorizer and sends an appropriate set of rules. The promotional device may
27 have multiple sets of rules implemented using various methodologies, *e.g.*, decision tree,
28 neural network, etc., that correspond to different portable devices.

29 For each question, the categorizer determines whether it knows the answer based
30 on information already stored in the portable device in step 311. If not, it checks to see
31 whether it is configured to interrupt the customer in step 313. If so, it queries the
32 customer for the answer in step 315, and then caches the answer in step 317. If the
33 portable device is configured so that it cannot, or may not, interrupt the customer, then the
34 categorizer caches a "don't know" answer in step 319.

Once answers to all of the rule questions have been determined, the rules are run in the categorizer to yield a customer category-specific to the business in step 321. The category is sent to the business' promotional device in step 323. When the category code has been received by the business, in step 325, the business can then take appropriate action. In one embodiment, the business customizes offers or advertising based on the category code, in step 327. Once an offer has been customized, it is sent to the customer (step 331) or printed in the form of a coupon or advertisement (step 333). In an alternative embodiment, a particular sales person is selected and notified to wait on this particular customer in step 335.

The customer continues to shop without answering any additional questions. If the categorizer desires additional information to provide a higher quality categorization, it will ask the customer for the information at a later time. While the customer shops (step 341), the portable device notes and captures the customer's behavior in step 343. For instance, if the device is also used for purchasing, it may keep track of items purchased and money spent. If it has access to location information, it can track the customer's movement (either by latitude/longitude position or, via beacon information, between departments and displays in the store). If the portable device has, for instance, a barcode reader or camera, the customer can tell it about items of interest via scanning, and it may be able to notice objects the customer interacts with. If the portable device is connected to a biometric monitor, it may be able to record the customer's excitement level. If it has a microphone, it may be able to overhear, record, and interpret conversations the customer has with salespeople. It will be apparent to one skilled in the art that a variety of behavioral aspects of the customer may be captured and stored. Once the customer leaves the business in step 345, the portable device asks the customer for answers to questions whose answer it did not know, and which were requested by the rules, in step 347.

In alternative embodiment the business is an e-business on a global computer network such as an Internet and it may or may not have a brick and mortar facility. The customer will not physically enter the store or business, but virtually enters the business by viewing an appropriate home page or web page or logging into the e-business or service from, for instance, a home computer. Instead of running a categorizer in a portable device, in one embodiment, the categorizer is run on a device used to access the e-business by the customer. This is typically done with a personal computer (PC), but an alternative embodiments access to the e-business might be via wireless telephone or

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1 wireless PDA or by other means. In this embodiment the business detects the presence of
2 the customer by virtue of the fact that the customer has electronically connected to the e-
3 business, for instance by downloading the web pages from the business' site. In this
4 alternative embodiment, when the customer accesses the e-business' web page, the e-
5 business sends the decision procedure. In this case the e-business sends the decision
6 procedure electronically to the customer and the categorizer on the customer's device is
7 run using that decision procedure.

8 In another alternative embodiment, the customer may desire not to answer
9 questions using the portable device. In this case the portable device will be synchronized
10 with a less portable computing device, such as a home computer or PC. The set of
11 questions required by the decision procedure will then appear on a display device on the
12 customer's home computer. The customer will answer the questions using a standard
13 keyboard or other typical input method. In this way the customer will not be required to
14 answer the questions using the portable device because the ergonomics of the portable
15 device may not be amenable to answering a significant number of questions. It may be
16 more comfortable or convenient for the customer to answer these questions using a home
17 computer. The portable device is synchronized with the home computer and the decision
18 procedure will run. In some embodiments, the categorizer runs on the portable device
19 and in some other embodiments it runs on the home computer. If the decision procedure
20 is run on the home computer a category will then be sent to the portable device for future
21 communication with the business. In other embodiments the answers to the questions
22 will be sent to the portable device and the portable device will run the decision procedure
23 and result in a category to be sent in the future to the business. In this way, some
24 questions can be answered by the customer directly on the portable device. If a
25 significant number of questions are required, the customer may decide to answer some of
26 them later on a home computer and synchronize it to the portable device.

27 In an exemplary embodiment, the portable device contains an application for
28 categorizing and communicates with a business' promotional device. Referring now to
29 FIGURE 4, there is shown a block diagram of the interaction between a customer's
30 portable device and a business' promotional device. In this exemplary embodiment, the
31 portable device is a customized PDA 400. The PDA 400 communicates with the
32 promotional device 410 either wirelessly or via a connection like a cradle. The PDA runs
33 a set of applications 402 as are used in the prior art, *i.e.*, calendar, phone lists, calculator,
34 etc. The PDA also has a categorizer application 404 loaded in memory. The categorizer

1 holds the historical behavior of the customer and is designed to run a decision procedure,
2 where the rules 406 are input from a promotional device 410.

3 The promotional device 410 detects the proximity of the PDA by means of a
4 proximity detector 412 in a variety of ways. In one embodiment, the customer places the
5 PDA in a cradle 414 connected to the promotional device. In another embodiment, the
6 promotional device detects the presence of the PDA at the entranceway to the business
7 establishment, for instance, in the same manner as inventory control devices detect
8 shoplifted items. In an embodiment where the business is an e-business, the promotional
9 device detects the customer by virtue of the customer logging on to the business' web
10 site.

11 The promotional device is connected to a means for outputting promotional
12 information. In this exemplary embodiment, the promotional device is connected to a
13 printer 416. The printer 416 prints coupons, advertisements, or other appropriate
14 promotional literature. For instance, if the category is bargain hunter, the promotional
15 device might print a 25% off coupon for a specific item, or non-specific item. If the
16 category is gadget freak, the promotional device might print out the technical
17 specifications for a featured item. In an embodiment where the customer is connected to
18 an e-business on the Internet, promotional literature may be sent via e-mail, or appear as a
19 pop-up window, or appear as a hyperlink to a separate web page. If the category is status
20 seeker, the promotional device might notify a sales person to provide assistance, if the
21 business perceives customers of that category to require personal attention. In an
22 alternative embodiment, the promotional device sends a wireless electronic message to
23 the customer's PDA which displays information or a promotion while the customer is in
24 the store.

25 In an alternative embodiment the customer may want to perform a sensitivity
26 analysis to determine whether information is being revealed. This would take the form of
27 playing "what if" game, such as, "what if I held one answer constant and varied the
28 others?" If the answer doesn't change then a lot of information about that answer is being
29 revealed. In the general case, one may try many different possible sets of answers and
30 use the laws of probability to estimate the likelihood that a customer gave an actual
31 answer, given the final result. Since the merchant can also perform this same calculation,
32 one can see how much information one is giving away. For instance if a rule is run and
33 the result is class 751 and a sensitivity analysis is then run, it may be determined that 95%
34 of time class 751 identify as a female. The customer may feel that this is giving away too

1 much information to a merchant; the merchant can assume that this customer is female
2 based on the response. If a customer decides that this is sensitive information, an
3 alternative embodiment is to be able to selectively decline to state a certain answer.

4 In another alternative embodiment there may be configurable safeguards to
5 prevent the accidental leak of information. In addition to sending the decision procedure
6 or rule set, merchants will likely identify themselves by passing an identity token or a
7 digital certificate signed by a trusted party. The customer's device may be configurable
8 to refuse to interact with, or only interact with, certain merchants or merchants with
9 credentials from a particular agency. The identity of the merchant may also be used to
10 restrict the questions that can be asked. Some merchants, but not others, may be allowed
11 to ask of the customer's income level or sexual preference. This may be done on a per
12 merchants/agency basis or the merchant or agency identity may be used to assign a trust
13 level with a configuration based on this trust level.

14 This aspect may be combined with the embodiment using sensitivity analysis.
15 The customer may be able to specify a sensitivity level for each question. For a given
16 trust level the allowed uses can range from "do not answer" to "answer". Running
17 through levels of "answer, but only if the result doesn't reveal the answer with more than
18 X percent likelihood." It may also be useful for some trust levels to present to the
19 customer "this is the answer I got, and here are the questions the rules asked, and the
20 answers I gave", allowing the customer to confirm or withhold some of the information
21 before sending. This aspect also allows a customer to correct information that has
22 changed or that has been previously answered incorrectly, before sending the information
23 to the business or merchant.

24 The rules themselves may represent significant investment or competitive
25 advantage for a merchant. Thus, the merchant may want to take steps to prevent their
26 decision procedures from being reverse engineered. In an alternative embodiment, a
27 merchant will give the classes obscure names, for instance "class 21" rather than "push
28 the DVD player." A merchant may also want to do other things to hide the details of the
29 rules such as splitting their classes into several parts. Thus classes 41, 241 and 357 may
30 all really be "likes to browse in peace." To prevent people from combining answers to
31 reverse engineer the rules or decision procedure, a merchant may choose to alter the
32 assignment of categories each time. Thus, what is class 21 for one customer will be
33 reported as class 743 for another customer. If this is done, a notation of which mapping is

1 being used needs to be sent to the merchant and returned to the customer, or simply
2 remembered, if there is actual communication between the merchant and the device.

3 In an alternative embodiment, the decision procedure is run by a trusted third
4 party and not on the customer's PDA or PC. This trusted third party may be selected by
5 either the merchant or the customer, or approved by both. In this embodiment, the
6 customer needs to identify himself in some way, which could be done by an active badge,
7 a cell phone, swiping a card, a secure keypad with a changing password, or in some other
8 method. It will be apparent to one skilled in the art that a variety of secure identification
9 methods may be used. For instance in the case of on-line browsing the PC itself may
10 automatically send an identification code. Once the merchant has acquired the identity, it
11 can be handed along with the decision procedure to the trusted third party. The particular
12 third party to use may be the choice of the customer, either given along with their identity
13 or looked up based on their identity. Thus, the merchant in this case would have a
14 mapping of identities and which third party to use. In other cases, the merchant may be
15 the trusted third party. If the merchant's rules are stable over time, it will be possible for
16 the merchant to simply pass its identity where the rules are already cached on the third
17 party device. In other cases, the merchant passes its identity and an indication of the rule
18 or decision procedure to use. There are several advantages to this alternative
19 embodiment. First, if the merchant trusts the third party, it need not resort to obfuscation
20 to try to prevent reverse engineering of its rules. Second, the third party is likely to have
21 far more computing power than a PDA and so it can more easily perform a good
22 sensitivity analysis. In addition, since the third party is likely to see the same rule many
23 times for different customers, it can cache the results of the sensitivity analysis. A
24 downside to this is that if the information requested is not in the third party's database, it
25 will be more difficult to query the customer in off-line scenarios. Presumably, the trusted
26 third party would fill in the database at a later time when the customer is online, perhaps
27 by e-mailing to the customer a questionnaire or a pointer to a questionnaire, or for
28 instance, a hyperlink, which would ask the answers and sensitivity level for the questions
29 that it could not answer. The method used to send the identity of the customer to the third
30 party need not give any information about the customer. The identity information may be
31 uniquely generated for a particular session by taking an actual identity number, blinding it
32 by concatenating it with a random number and encrypting it with the third party's public
33 key. The third party can decrypt and throw away the random part to get the actual
34 identity number, but the merchant has not gotten any information. It will be apparent to

those skilled in the art that a variety of methods may be used to mask the actual identity of the customer from the third party.

In another embodiment, customers can chose to share their information based on the defined uses of that information by the merchant. For instance, in online commerce, or e-commerce, there is a standard called PPP (Platform for Privacy Protection) by which websites notify the users of what information they collect, what it is used for and how it is used. In this embodiment, the merchant defines what the categorization code is used for. The customer may then chose whether or not he is willing to answer a question needed by the decision procedure based on the intended use for the categorization code. For example, a customer may decide that he is willing to answer the questions if the categorization code is defined for deciding what to present to the customer during this particular shopping trip or for general purchasing decisions. However, the customer may not wish to answer questions if the categorization code is being used to decide whether to direct junk mail or advertisements to the customer. In order to be useful, this assertion for the use of the categorization code would be necessary to be signed by a trusted auditor who verified that indeed this is what the merchant does with the categorization. It will be apparent to one skilled in the art that there exist several different organizations now that are third parties who verify merchant privacy protection procedures or other aspects of the e-business where a customer desires an additional level of trust to ensure that the merchant is complying with its own set of rules and policies.

A business may determine that some of the inputs to its decision procedure depend on factors outside of the particular customer's information. Examples of this may be time of day, day of the week, proximity to Christmas or other high volume purchasing holidays, geographic location, affluence of the area around the store, stock market trading volume or the previous day's consumption of hot dogs. In such cases, the actual rule sent to the customer may reflect the known answers to those questions at the present time, either by treating them as constants and sending simplified rules, or by having different rules sent in different situations.

In other cases, rules may be partially filled in before being sent to the customer, based on information that the merchant knows to be true about this customer. This information may be based on past interactions (prior purchases, prior visits, information tied to known account numbers) or inferred using physical observation (e.g., sex, race or age from image analysis and weight measured from in-floor scales).

1 While some information about the customer is stable, or reasonably so over time,
2 e.g., sex, race, birth date, marital status, favorite color, etc., other potentially useful
3 information is a function of the customer's current "mode." The appropriate response to
4 a particular customer may vary depending on whether they are on a quick trip to the store
5 for something that is needed or researching future purchase or looking for a gift or just
6 browsing in a store. Economists noticed long ago that a purchaser's behavior depends on
7 the beneficiary, i.e., who was to be the recipient of the purchased item. Other information
8 that might be useful to a merchant is at what time/date a particular gift is needed to be in a
9 particular place, or the particular pressure a customer is under and the reason for the
10 purchase, i.e., whether it is a regular grocery shopping trip, shopping for dinner with a
11 special guest, for a fraternity party or a candlelight dinner with a romantic interest. The
12 customer's device might be delivered pre-configured with a number of such modes
13 allowing the customer to easily select the ones that apply for the current shopping trip and
14 possibly to construct new modes.

15 Having described preferred embodiments of a novel method and system for
16 customer-side market segmentation, or categorization, (which are intended to be
17 illustrative and not limiting), it is noted that modifications and variations can be made by
18 persons skilled in the art in light of the above teachings. It is therefore to be understood
19 that changes may be made in the particular embodiments of the invention disclosed which
20 are within the scope and spirit of the invention as defined by the appended claims.